SUMMARY REPORT

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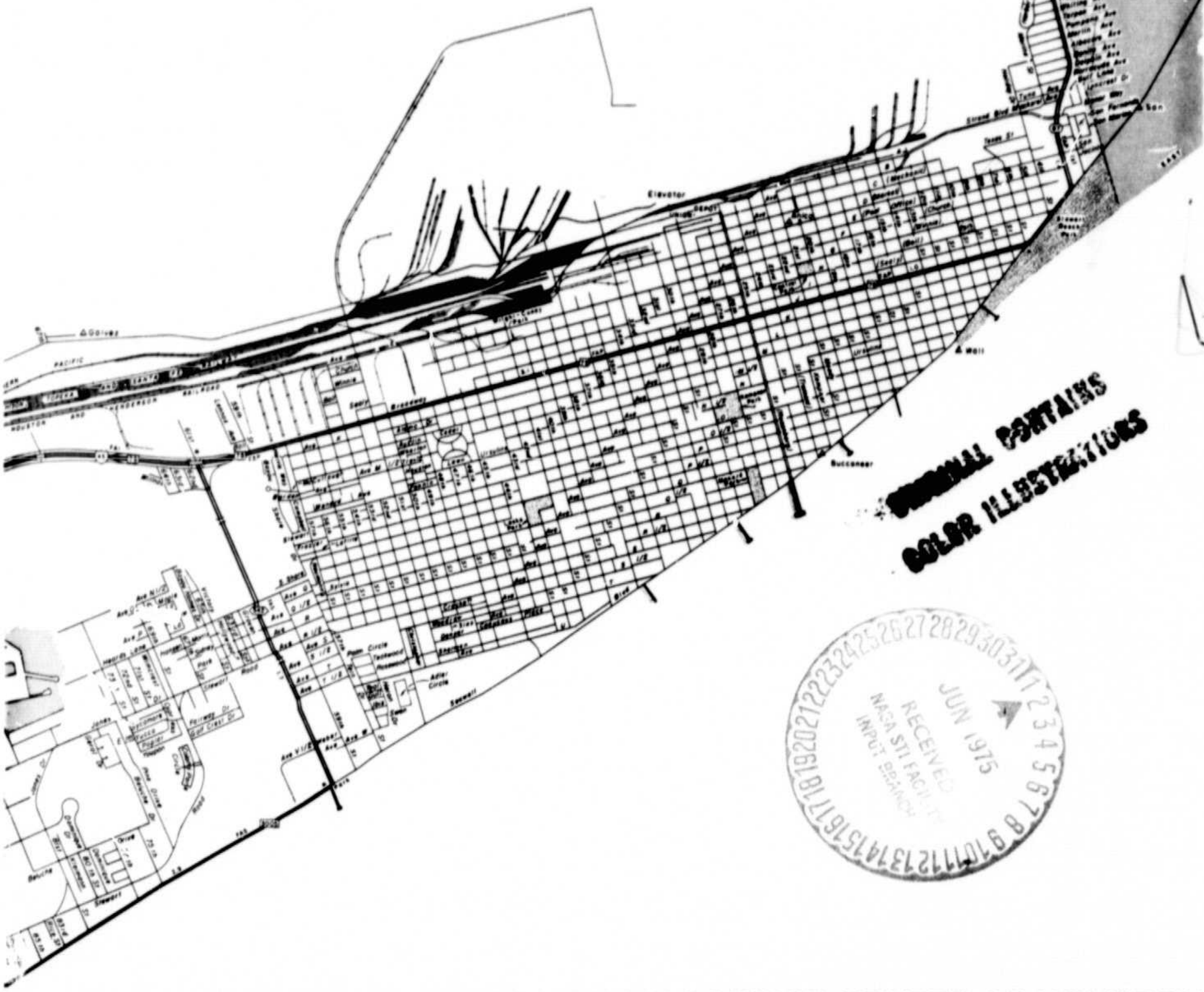
URBAN ENVIRONMENTAL HEALTH AND REMOTE SENSING

GALVESTON, TEXAS



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SUMMARY REPORT

URBAN ENVIRONMENTAL HEALTH APPLICATIONS OF REMOTE SENSING

Contract NAS 9-12823

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PREFACE

This summary is based upon a much more extensive report, entitled Urban Environmental Health and Remote Sensing, Galveston, Texas. The full report is a detailed description of the Galveston Remote Sensing project, including an extensive literature review, a full discussion of the methodology employed, the sampling techniques used, the variables selected and various tests of reliability and validity. The results of the computer analysis are also discussed fully in the complete report. Copies of this full report may be obtained from The Manned Spacecraft Center, National Aeronautics and Space Administration or from the School of Public Health, University of Texas at Houston.

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SECTION I

THE GALVESTON REMOTE SENSING STUDY: INTRODUCTION

An investigation of health and its association with the physical environment was carried out on data from Galveston, Texas. Basically the hypothesis was that there is a relationship between the man-made physical environment and health status of a population. This hypothesis was then broken down into six sub-hypotheses for testing. The statistical technique of regression analysis was employed in order to show not only the degree of association between health and the physical environment, but also which aspects of that physical environment accounted for the greater variation in health status.

The study selected eight basic health status indicators as dependent variables. These were mortality, venereal disease, tuberculosis, hepatitis, meningitis, shigella/salmonella, hypertension and cardiac arrest/ myocardial infarction (heart attacks). Five of these health variables fall into the category of communicable diseases while hypertension and heart attacks are chronic illnesses. Mortality includes deaths from all causes, that is, communicable diseases, chronic diseases, suicide and homicide.

The hypothesis of a relationship between the physical environment and health status does not imply a cause and effect relationship between specific environmental variables and health. The statistical techniques used measure association and variation only. The basic epidemiology of each of these diseases, and the environmental elements which could act as causal agents, remain to be investigated and isolated through different means. In other words, while poor housing and poorly maintained neighborhoods show a high degree of association with poor health, no causal

relationship is implied. There are many other reasons operative within the framework of these factors. Indeed, the association between poor neighborhoods and poor health was demonstrated decades ago; this is not a new discovery. The important conclusions drawn from the Galveston study are that the association still exists in the decade of the 1970's and that it can be successfully monitored with the methodology of remote sensing used in this study.

SECTION II

METHODOLOGICAL BACKGROUND

Remote sensing is generally defined as "sensing an object or phenomenon without having the sensor in direct contact with the object being sensed."[1] This report uses the terms "remote sensing" and aerial photography interchangeably in the context of land use monitoring and evaluation. Technically speaking however, remote sensing is far more comprehensive, including radar and other non-photographic sensors.

This study utilized infrared photographs at a viewing scale of 1:6000, which is a commonly used scale in detailed photo interpretation of urban areas. A special stereoscopic viewing machine was employed for the analysis process. The original scale of the photographs was 1:24,000.

Infrared photography is useful in viewing the environment. By recording a heat image, such things as the health of foliage and greenery can be discerned, without losing any of the clarity of a regular color photo. Infrared is especially useful in the differentiation of residential environmental quality. The more carefully cultivated and more abundant shrubs, flowers and trees of well tended areas, such as middle and upper income residential areas, can be readily discerned by recording strongly bright red, while neglected areas of vegetation and sparser areas of greenery show up greenish blue. Each is a measure of the amount of infrared radiation emanating from the ground.

Infrared is also useful in the assessment of water temperature and depth and in thermal pollution detection. In addition, roofing and

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1. Holz, Robert, Introduction to The Surveillant Scene. See Bibliography for references regarding remote sensing.

construction materials can be classified by their heat emission, using infrared sensing devices. Infrared sensors and photographs are increasingly being used in the analysis of both urban and rural environments, as infrared has proven to be more effective than color or black and white for certain purposes of analysis and classification.

Figure 1 shows a section of the City of Galveston in an infrared photograph. This was the same photograph, enlarged and viewed through a special stereoscopic viewer, which was used for this study.

Uses of Remote Sensing in Urban Environmental Studies

Over the past 15 years, there has been an acceleration of remote sensing studies and practical applications of remote sensing for urban environmental areal evaluation. These studies and projects have taken two basic forms: first, the inventory and monitoring of land uses through remote sensing on neighborhood-wide, city-wide and region-wide levels, and second, the evaluation of the quality of urban environments through assessment of certain urban characteristics which can be studied through remote sensing. A third basic use of remote sensing has been in the prediction of population growth and change, but this is essentially a composite of the two basic forms just mentioned, in that it uses housing counts as a basis for population predictions and evaluates land use changes over time.

Inventories of Land Uses

The first form of remote sensing falls into two basic categories: those inventory studies interested in environmental data on a "macro" or wide area basis, and those interested in a "micro" or small area inventory and monitoring. Generally speaking, there has been an extensive use of ERTS (Earth Resources Technology Satellite) photographs for use on a macro, or regional basis in the assessment and inventory of land uses and

environment. This level is ideal for large urban areas: such places as metropolitan Boston and Washington, D.C. areas, the southern California region, the Phoenix SMSA, and the Houston metropolitan area have been studied with ERTS imagery. The Census Cities Project undertaken by the U.S. Department of the Interior using ERTS Imagery is currently proceeding in eight test cities of the 26 cities selected as an experiment in urban change detection.

There have also been numerous studies of micro areas in order to inventory land uses on a more detailed basis. The Washington, D.C. Council of Governments is undertaking an extensive inventory of land uses and the man-made environment using larger scale photography than that of ERTS.[1]

One of the problems with land use inventory studies is the land classification system utilized. As yet, no ideal classification system has been developed and used nationwide. This problem of a uniform land use classification system has always existed between cities and states; however, the problem is somewhat compounded in that not only does no uniform system exist for traditional ground survey inventory, but also differences exist between a classification system appropriate to remote sensing and one appropriate to ground surveying. Until this two-fold problem can be worked out the land classification of urban areas will remain problematic.

One proposal has been offered by the Inter-Agency Steering Committee on Land Use Information and Classification under the U.S. Geological Survey.

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1. Mallan, Harry "Remote Sensing Applications in the Metropolitan Washington COG," in Proceedings of the Eighth International Symposium on Remote Sensing, Ann Arbor, Michigan.

For an extensive review of the literature testing these various studies, refer to the <u>full</u> report of this Research Project.

This Committee has proposed a four-level classification system, starting with a first level of classification on a macro basis, and allowing local areas the opportunity to develop down to fourth level of classification on a micro basis which is consistent within the broad areas of Level I. This classification system is given in Figure 2. For our purposes, the focus should be on the 01. category, urban and built-up land for Level I and for Level II, the 01. to 09. categories within urban and built-up land. The land use classification scheme used in this study attempted to follow the Level II categories as closely as possible. This scheme appears later in this summary in Figure 3.

Studies of Urban Environmental Quality

During the latter part of the decade of the 1960's when there was an increasing need for data on urban poverty areas, several studies were undertaken to determine the applicability of remote sensing in measuring the quality of the man-made environment, and specifically, in determining the location of urban poverty areas. Studies were carried out in San Juan, Puerto Rico, Los Angeles, California, Austin, Texas, and Lexington, Kentucky, among other cities. These studies successfully demonstrated the utility of remote sensing in delineating urban poverty areas. Some of the variables which proved to be the most telling indicants of poverty areas were litter, unpaved streets, small lot, narrow house frontage, and on-street parking.

Probably the most extensive study carried out to assess housing and environmental quality was done in Los Angeles by the City Community

FIGURE 2

Land-Use Classification System for Use

With Remote Sensor Data

Level I	Level II
01. Urban and Built-up Land.	
	01. Residential.
	02. Commercial and services.
	03. Industrial.
	04. Extractive.
	05. Transportation, Communications, and Utilities.
	06. Institutional.
	07. Strip and Clustered Settlement.
	08. Mixed.
	09. Open and Other.
02. Agricultural Land.	
	01. Cropland and Pasture.
	02. Orchards, Groves, Bush Fruits, Vineyards, and Horticultural Areas.
	03. Feeding Operations.
	04. Other.
03. Rangeland.	
	01. Grass.
	02. Savannas (Palmetto Prairies).
	03. Chaparral.
	04. Desert Shrub.
04. Forest Land.	
	01. Deciduous.
	02. Evergreen (Coniferous and Other).
	03. Mixed.
05. Water.	
	01. Streams and Waterways.
	02. Lakes
	03. Reservoirs.
	04. Bays and Estuaries.
	05. Other.
06. Nonforested Wetland.	
	01. Vegetated.
	02. Bare.
07. Barren Land.	
	01. Salt Flats.
	02. Beaches.
	03. Sand Other Than Beaches.
	04. Bare Exposed Rock.
	05. Other.
08. Tundra.	
	01. Tundra.
09. Permanent Snow and Icefields.	
	01. Permanent Snow and Icefields.

Analysis[1] Bureau and by independent researchers working with the Los Angeles Health Department (for a listing of the outstanding studies in this area, see the References to this report). These studies involved both identifying areas of the city which contained poor housing, with the attendant correlates or indicators of this housing, and testing to see which variables of environmental quality were identifiable with remote sensing and which were not. An earlier study was also carried out which sought associations between environmental quality and certain socio-economic and health variables. This Los Angeles study by Robert Mullens[2] was useful in determining the approach to use and the variables or indicants of the environment to employ in the Galveston public health investigation.

The final selection of variables and the approach used is discussed in Section III. Before coming to that however, it may be useful to look at the advantages and disadvantages of remote sensing.

Assets of Remote Sensing

The assets of remote sensing can be summarized as follows:

1. Information can be collected speedily and frequently through remote sensing compared to ground survey.

2. Information can be stored easily and permanently in the form of aerial photographs.

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1. Mullens, Robt, and Johnson, Chas., A Practical Method for the Collection and Analysis of Housing and Urban Environment Data, Los Angeles Community Analysis Bureau, April, 1970.

2. Mullens, Robt., Analysis of Urban Residential Environments Using Color Infrared Aerial Photography: An Examination of Socioeconomic Variables and Physical Characteristics of Selected Areas in the Los Angeles Basin. Dept. of Geography, University of California, 1969.

3. Information can be retrieved quickly and easily for further analysis.

4. Information on an aerial photograph can be multi-purpose depending upon the need and use demands of the investigator. Therefore, photos taken for one purpose can be used for other purposes later as the need arises.

5. The total physical environment can be viewed rather than just one parcel at a time.

6. Aerial photography can be interpreted by anyone with a minimum of training and some knowledge of land use and housing pattersn.

7. Remote sensing not only saves time, but in some cases saves money as well, in terms of manhours expended on land use evaluation and inventory. One estimate has it that a 100% survey of a city over 500,000 population by remote sensing can be carried out in the same time frame as a 10% survey in that same city by conventional ground survey means.

8. Finally, remote sensing can act as a continual data base, while other data will become outdated rather quickly. This is the advantage that remote sensing has over the decennial census.

Liabilities of Remote Sensing

Remote sensing is not without its drawbacks. The first is the dependence upon the subjective interpretation of the image analyst which can yield incorrect identification of certain types of land uses and quality indicants. The second is the inability of the photo interpreter or image analyst to differentiate between land uses which look similar from the air but which are dissimilar at ground level. Finally, there is

the problem of a classification scheme which will be acceptable to both city planners and image analysts.

The problem of subjective interpretation exists not only with image analysts involved in the non-contact science of remote sensing but also in any ground field survey undertaken for housing or land use quality. The judgmental aspects of image analysis are as subject to error as those of the traditional field survey. While this error is somewhat enhanced on the one hand due to the distance removed from the subject, it is also reduced on the other hand in that a consistent pattern can emerge more readily when viewing an entire mosaic of neighborhoods, than if one were viewing one house or one block at a time. Therefore, while this element of subjective interpretation should be counted as a liability, this same liability is shared by those engaged in contact field surveys of the environment.

The problem of the inability of the image analyst to differentiate between certain types of land uses which appear very similar from the air, is perhaps the most frequently encountered problem in remote sensing research and utilization. Especially vulnerable to misinterpretation are the following: dwelling units which appear to be single family units when they are actually duplexes or multi-family; commercial uses on the ground floor of a building otherwise used for residential dwellings; institutions such as nursing homes or group homes which appear as apartments; certain kinds of commercial uses which appear as industrial uses and vice-versa, and open space or vacant areas which are meant to be used for recreational purposes. It is always advisable, therefore, that in areas where some doubt arises as to the correct interpretation, a

ground truth or ground verification be carried out.

In some remote sensing studies, attempts have been made not only to identify different types of dwelling units, but to make population estimates based on the numbers of these different types; i.e. single family and multi-family. Efforts in this direction have not been totally successful, with image analysis estimates generally running higher than census estimates on all single-family residential dwellings and lower than census counts on multi-family housing.

<u>Comparison of Remote Sensing Generated Data and Census Data</u>

Data generated through remote sensing is to a degree an excellent substitute for census data in the interstices between census periods when information rapidly becomes outdated. Remote sensing, while beneficial, has certain basic limitations. Table 1 gives a listing of those housing variables observable through remote sensing. Table 2 gives another listing of housing and environmental quality indicants which are observable with remote sensing and those which are not. A brief review of these two sets of variables should indicate the limitations of remote sensing analysis in urban studies.

Nevertheless, as further research reveals the increasingly successful use of remote sensing as a means to identify surrogate measures for socioeconomic status, its substitution for census data will become more acceptable. Studies already carried out have shown that such things as housing density (number of houses per block), litter, maintenance, street conditions and house size are all surrogate measures for socioeconomic status which can be relied upon with some degree of statistical significance. The Galveston study confirms that for certain types of diseases which are

ORIGINAL PAGE IS
OF POOR QUALITY

TABLE 1

ENVIRONMENTAL CRITERIA USED IN THE

EVALUATION OF HOUSING QUALITY*

Item	Criteria Used by APHA	Criteria Extractable from Imagery	Extractable Criteria Used in Housing Quality Study
A. LAND CROWDING			
1. Coverage by Structures	X	X	X
2. Residential Building Density	X	X	X
3. Population Density	X		
4. Residential Yard Areas	X	X	X
5. Building Frontages		X	X
6. Multiple versus Single Unit Structures		X	X
B. CONDITION OF PRIVATE FREE SPACE			
7. Landscaping		X	X
8. Condition of Grassed Areas		X	X
9. Presence of Litter or Garbage		X	X
C. NONRESIDENTIAL LAND USES			
10. Areal Incidence of Nonresidential Uses	X	X	X
11. Linear Incidence of Nonresidential Uses	X	X	X
12. Specific Nonresidential Hazards and Nuisances	X	X	X
13. Smoke Incidence	X	X	X

*Source: Barry S. Wellar. "Utilization of multiband aerial photographs in urban housing quality studies," Proceedings of the Fifth Symposium of Remote Sensing of the Environment. Ann Arbor: University of Michigan, p. 917.

TABLE 1 (Continued)

Item	Criteria Used by APHA	Criteria Extractable from Imagery	Extractable Criteria Used in Housing Quality Study
14. Hazards to Morals and Public Peace	X		
15. Non Structure-supporting Land (Utilized)		X	X
16. Non Structure-supporting Land (Unutilized)		X	X
17. On-street Parking		X	X
D. HAZARDS AND NUISANCES FROM TRANSPORTATION SYSTEM			
18. Street Traffic	X	X	X
19. Railroads and Switchyards	X	X	X
20. Airports	X	X	
21. Alleyways		X	X
E. HAZARDS AND NUISANCES FROM NATURAL PHENOMENA			
22. Surface Flooding	X	X	
23. Swamps or Marshes	X	X	
24. Uneven Ground	X	X	
F. INADEQUATE UTILITIES AND SANITATION			
25. Sanitary Sewage System	X		
26. Public Water Supply	X		
27. Streets and Sidewalks	X	X	X
28. Condition of Parkways		X	X
G. INADEQUATE BASIC COMMUNITY FACILITIES			
29. Elementary Public Schools	X	X	X

TABLE 1 (Continued)

Item	Criteria Used by APHA	Criteria Extractable from Imagery	Extractable Criteria Used in Housing Quality Study
30. Public Play-grounds	X	X	X
31. Public Play-fields	X	X	X
32. Other Public Parks	X	X	X
33. Public Trans-portation	X		
34. Food Stores	X		

TABLE 2

STRUCTURAL AND ENVIRONMENTAL VARIABLES

UTILIZED IN THE LOS ANGELES STUDY*

1.	Land Use - suitability for residential devt.	
2.	Condition of Street Lighting	
3.	Presence of On-Street Parking	
4.	Street Width	
5.	Street Maintenance	
6.	Street Grade	
7.	Condition of Parkways	
8.	Hazards From Traffic	
9.	Adequacy of Public Transportation	Variables Potentially Measurable Using Remote Sensors
10.	Number of Buildings/Lot	
11.	Number of Units/Lot	
12.	Condition of Fences	
13.	Adequacy of Lot Size	
14.	Access to Buildings	
15.	Condition of Sidewalks	
16.	Condition of Landscaping	
17.	Refuse	
18.	Parcel Use	
19.	Adverse Effects of Residences	
20.	Nuisances from Loading/Parking	
21.	Unclassified Nuisances from Industry etc.	
22.	Overall Block Rating	
23.	Noise/Glare (block)	
24.	Smoke	
25.	Condition of Accessory Buildings	
26.	Premise Rating	
27.	Noise, Fumes and Odors (Parcel)	Variables Not Observable Using Remote Sensors
28.	Construction Type	
29.	Age of Dwelling	
30.	Condition of Structure	
31.	Condition of Wall	
32.	Condition of Roofs	
33.	Condition of Foundation	
34.	Condition of Electrical Installations	
35.	Condition of Paint	
36.	Other Exterior Factors	
37.	Overall Parcel Rating	

*Source: Frank E. Horton and Duane F. Marble, "Housing quality in urban areas: Data acquisition and classification through the analysis of remote sensor imagery," in Second Annual Earth Resources Aircraft Program Status Review. Vol. I, Part 15, Manned Spacecraft Center, Houston, Texas, 1970, p. 7.

related to socioeconomic conditions, the physical environment can be used as a surrogate with some measure of success.

While it is not advisable to utilize the tool of remote sensing as a substitute for census evaluation entirely, between censal periods it can be effective as a monitoring device. The combination of image analysis and census data is by far the most ideal and wherever feasible both should be utilized. Very high correlations between environmental quality measures and certain census variables were revealed by this study and once their validity is proven, these surrogate measures can be employed.

SECTION III

LOGISTICS OF THE STUDY

Land Use Classification Scheme

As stated earlier, a land use classification scheme which is acceptable to both a city planner and an image analyst is not easy to devise. Figure 2 in the earlier part of this text showed the classification scheme developed by the Inter-Agency Steering Committee of the U.S. Geological Survey. Although followed to a large degree, some changes were made based on the peculiarities of Galveston. The final classification is given in Figure 3. Differences in the two systems lie in the category under the Inter-Agency classification of "mixed, strip and clustered settlement" which was not used in our study, and in the category of "water" which does not appear in the government classification. Water was included as a separate category due to the nature of Galveston's environmental character, but it did not prove to be a useful category for analytical purposes in this study. The other category which was separated out for analysis purposes in the Galveston classification was "vacant and unimproved land". Under the government classification scheme this would have appeared as "open and other".

The final work sheet used by the image analyst included both land uses and quality indicators. It appears as Figure 4. A discussion of the quality indicators or factors used in the analysis appears in the following pages.

Analysis of Residential Quality

In developing a methodology for assessment of urban residential quality through the use of remote sensing, one of the problems is the

FIGURE 3

COMPARABLE LAND-USE CATEGORIES

Galveston: Land-Use Categories	U.S. Geological Survey: Land Use Categories Level II Classification
<u>Residential</u> R - Single family dwelling RA - 1-3 story dwelling RH - Over 3 story dwelling Trailer Parks	Residential
no comparable category	Mixed* Strip & Clustered Settlement
Community Facilities	Institutional
Recreation & Open Space	Open and Other
Water	No comparable category
Streets, Highways, Parking Lots	Major transportation routes
Commercial	Commercial & Services
Industrial	Industrial
No comparable category	Extractive
Vacant & unimproved	

*This category has not been included as such in the initial classification scheme but will appear later when blocks with 50% or less residential use are isolated and aggregated as a new category.

FIGURE 4

BLOCK NO. *1251* BLOCK GROUP NO. *215g* LAND USE CATEGORIES CENSUS TRACT NO. ____

Total Sq. Ft.: *1867000*

CODE	AREA SQ. FT.
F-Community Facilities	
1-School	
2-Churches	
3-Fire & Police Stations	
4-Developed rec. areas	
5-Civic Buildings	
6-Hospitals & Medical	
O-Open Space & Rec. Areas	
1-Parks & Playgrounds	
2-Country Clubs	
3-Baseball, Football	
4-Freeway & Grassy Basements	
5-Cemeteries	
W-Water	
1-Lakes	
2-Bayous & Rivers	
3-Reservoirs	
S-Streets	
Parking Lots	
C-Commercial	
1-Retail Outlets	
2-Motels & Hotels	
3-Office & Other	
I-Industrial	
1-Large Manufacturing	
2-Light Industrial	
3-Wholesale & Warehouse	
V-Vacant & Unimproved	*1,867,000*

	NO. OF HOMES	AREA SQ. FT. Nearest 10%		
R - Residential				
R - 1-Single Family				
H - 2-Multi Family 1-3 Story				
A - 3-Multi Family Over 3 Story				
		Low Less than 25%	Med 25-75%	High Over 75%
A-Amount of Foliage & Green Lawn				
B-Presence of Sidewalks				
C-Presence of Driveway & Garage				
D-Street Width Over 30 Ft.				
E-Paved Street				
F-Curbs & Gutters				
G-Litter		Yes or No		
H-Frontage of Houses				
a-Over 90 Ft.				
b-50 to 90 Ft.				
c-Less than 50 Ft.				
I-Size of Houses				
a-Large (over 2000 sq. ft.)				
b-Medium (1200-2000 sq. ft.)				
c-Small (1200 or less sq. ft.)				
J-Quality				
a-Exc				
b-Good				
c-Poor				
	AREA SQ. FT.	REMARKS:		
T - Trailer Parks				

selection of photo indicators which will prove to be adequate surrogates in classifying this quality. These indicators or factors must serve two purposes: they must be readable to the photo interpreter and they must be objective enough to permit both manipulation mathematically and to allow replication by other researchers. While complete objectivity is not possible when measuring quality, it is essential to utilize as many indicators which lend themselves to objective measurement as possible.

As mentioned previously, several of the major remote sensing studies of the last few years have developed sets of these quality indicators. They were reviewed to determine applicability to the Galveston area and from this review, ten quality factors were selected which, taken either individually or as a composite measure, yielded a measurement of residential quality which was pertinent to the test area. Table 3 lists these quality factors, as well as other studies in which these factors appeared.

The amount of foliage (trees and shrubs) and green lawn has been found to be a useful measure of urban quality in virtually every one of the above mentioned remote sensing studies. Greenery and foliage is directly correlated to better housing quality while its absence is a correlate of poor environmental quality. Utilizing this factor for Galveston yielded some interesting results, inasmuch as there are some areas of the city with little open green lawn, and very dense housing which are nevertheless considered to be middle income areas, socioeconomically. They are atypical of the middle class housing of the Southwest which is generally single family surrounded by green open space. In general, the results showed that foliage did not prove to be a strong quality variable, but that when it did appear, both the direction and the strength of the association were positive for middle and upper income housing and negative for lower income neighborhoods.

TABLE 3

QUALITY INDICANTS USED IN GALVESTON STUDY

Quality Indicant	Previous Appearance in Literature
Foliage	Used by Davies, Holz (Austin, 1973), Wellar (Chicago, 1968), Bowden (Los Angeles, 1968), and Mullens (Los Angeles, 1969).
Sidewalks	Used by Mullens (Los Angeles, 1969) under overall category "Streets"
Curbs and gutters	Used by Davies, Holz (Austin) and Mullens (Los Angeles)
Paved Streets	Used by Davies, Holz (Austin) and Mullens (Los Angeles)
Garage and Driveway	Used by Bowden (Los Angeles) under "parking and number of cars", Moore (Los Angeles, 1970) under "on street parking" and by Davies, Holz (Austin)
Street Width	Used by Davies, Holz (Austin), Mullens (Los Angeles) and Moore (Los Angeles)
Litter	Used by Davies, Holz (Austin), Mullens (Los Angeles) and Moore (Los Angeles)
Lot Frontage	Used by Davies, Holz (Austin)
Size of house	Used by Bowden (Los Angeles, 1968), Wellar (Chicago), Mullens (Los Angeles) and Davies, Holz (Austin)

Sidewalks have only been used in one study as an indicator of quality, and that was as a unit in a composite measure of general street quality. However, most urban poverty areas in the Houston-Galveston County area are characterized by lack of sidewalks and this factor was felt to be potentially useful for this purpose.

The lack of garages and driveways in many urban poverty areas has been noted by previous authors in studies using remote sensing. This factor is interchangeable with the title "on street parking". This characteristic is especially prevalent in poverty areas in the Southwest United States.

The presence of curbs and gutters in middle class developments is usually in sharp contrast to their absence in urban poverty neighborhoods, especially in the Houston-Galveston area. Paved streets usually accompany curbs and gutters in middle and upper income areas but often do not in lower income residential neighborhoods where the street has been hastily installed and drainage ditches remain. Therefore, it was felt that these two items should be separated for more careful analysis.

Litter is as widely used a factor as foliage and green open space. The presence or absence of litter is not a localized geographic occurrence but rather one which manifests itself in any urban area in the U.S.

Lot frontage has not been widely used as a quality/density indicant. It is generally assumed that smaller lots appear in low income housing areas due to the higher cost of larger residential parcels. In addition, shorter frontage reflects the trend for poverty areas to be subdivided into smaller tracts with less frontage to avoid larger property taxes. Again, there are some areas in Galveston which may prove the exception to

this general observation. These are the areas of high density, short frontage and older two story residences referred to earlier which could be described as middle income areas in some blocks, and as lower income areas in others. This measurement of frontage to indicate both density and quality showed an interesting association between these two groups of socioeconomic classes.

Size of house as a quality factor has been used in previous studies. Size is given in three sub-categories: small (1200 or less square feet); medium (1200-2000 square feet); and large (2000 plus square feet). A previous Texas study[1] grouped housing in roughly equivalent categories; low income areas revealed average sizes of from 380 to 1270 square feet, middle income areas from 1110 to 1560.

All of the above factors of housing quality have been delineated in a fashion so as to be measured objectively. Each is quantifiable in terms of <u>amount</u> so that there is less opportunity for subjective judgment to intervene. Thus, presence or absence of driveway, sidewalks, curbs and gutters, paved street, litter and foliage are recorded by percentages which can yield an ordinal scale. The scale quantities can either be aggregated into a composite measurement, or can be isolated and compared as separate quality factors for each health outcome.

The one exception to this system of classification is the factor "residential quality". This has been included to compare the relative accuracy of the image analyst's subjective judgment vs. objective

1. Davies, S., Tuyahov, A. and Holz, R.K. "Use of Remote Sensing to Determine Urban Poverty Neighborhoods," in <u>The Surveillant Scene Remote Sensing of the Environment</u>, Ed. by R. Holtz, Houghton, Mifflin, Co., 1972.

measurement of quality indicators. While it is obvious that even in objective measurement there is bound to be some subjectivity, it was hypothesized that there would be a difference between the two kinds of evaluation.

However, correlation analysis showed that the subjective evaluation did not differ significantly from the objective evaluation. This result was unexpected, and has led to the conclusion that while the objective evaluation included discreet quality indicators which are useful for analysis and research purposes and for monitoring purposes, where a time factor is involved, subjective evaluation of neighborhood and residential quality will suffice in terms of comparative accuracy with objective measurement.

Time Schedule for the Remote Sensing Project

From the first overflight of Galveston to the final writing of this research report, the Galveston Remote Sensing project occupied about 13 months of time, involving the Principal Investigator, one project director, one image analyst, three student statistical and research aides and a statistical consultant. This time frame included all data gathering from the Galveston hospitals and City Health Department, the analysis, recording and coding of the land use sheets, image analysis of some 1300 city blocks which comprised the total City of Galveston, and all of the usual coding, keypunching, computations and so forth involved with census data and health data analysis. The actual computer analysis, which was the last phase of the project, occupied about three months.

A work flow chart is included to give the reader a clearer picture of the work program for this study. Each phase of the project is called a "sequence" and has a time frame attached to it, Figure 5.

Time Involved in Image Analysis

One aspect of the research project important to potential urban studies using remote sensing, is the time involved in image analysis or photo interpretation. For this project it was determined that the image analyst was able to complete one census block at an average of 12-15 minutes per block depending upon the kinds and diversity of land uses involved. This meant that the work sheet shown as Figure 4 was completed in that length of time. In addition to the completion of the work sheet, this time frame included an outline on an overlay used to identify each block within each census tract in the city, annotation on this overlay of the type of land use analyzed, measurement of the quantity of each type of land use in square feet and a final four way cross-check for accuracy between the overlay, the light table, the census tract map, and a Galveston City Engineering map. The 1300 city blocks were analyzed in approximately 13 weeks.

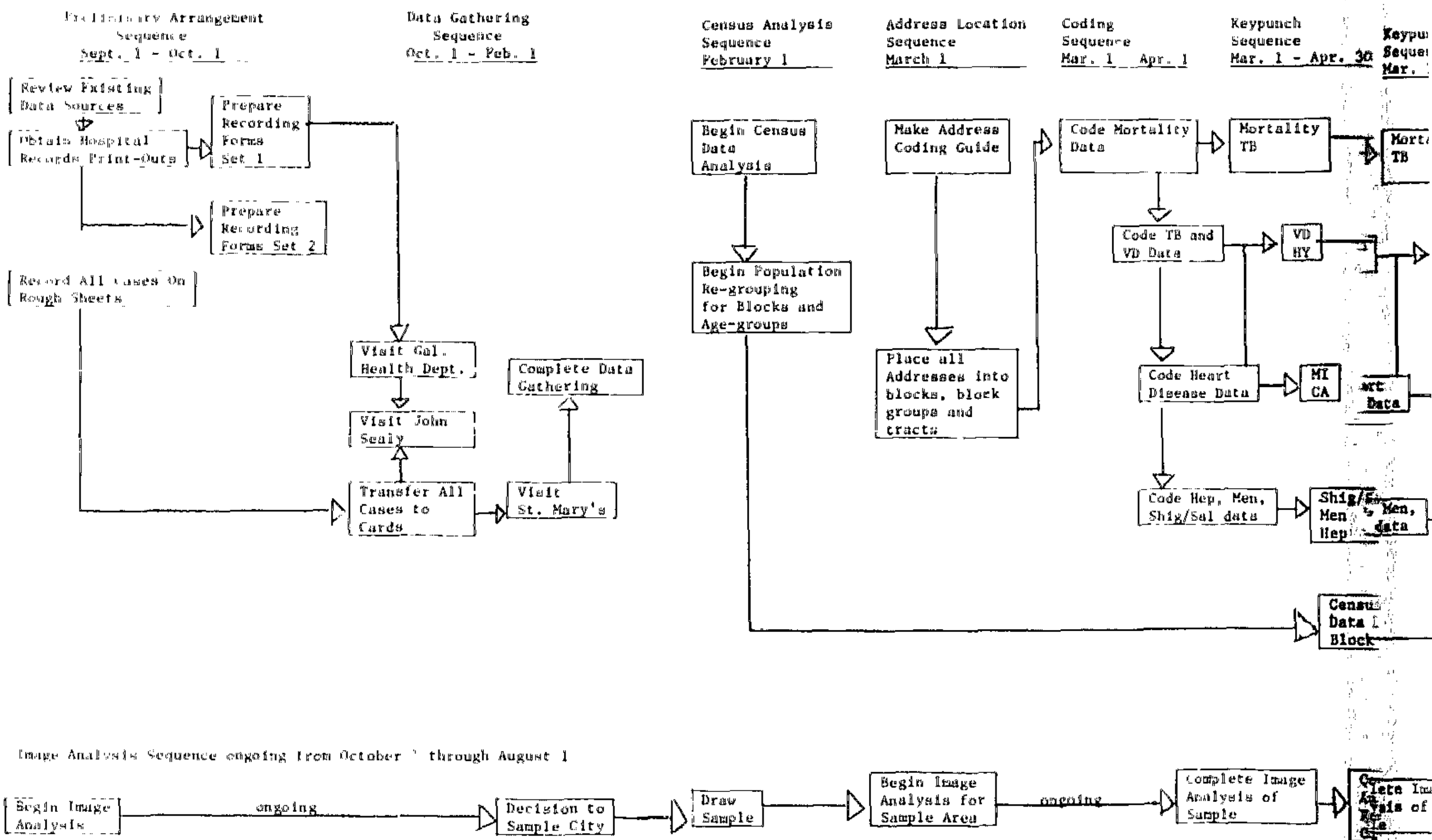
Briefly, the methodology used by the image analyst was to first look through a stereoscopic viewer which increased the size of the photographs from 1:24,000 to 1:6000 for purposes of analysis and to determine the kinds of land uses in each block and the quality of the residential areas in each block. The image analyst then used a grid of 100 x 100 to estimate area in each block and transformed this measurement via a slide rule to a square footage measurement. A previous pilot study had tested the reliability of four different methods of measurement, including

FIGURE 5

GALVESTON WORK FLOW CHART

WORK PROGRAM: GALVESTON PROJECT

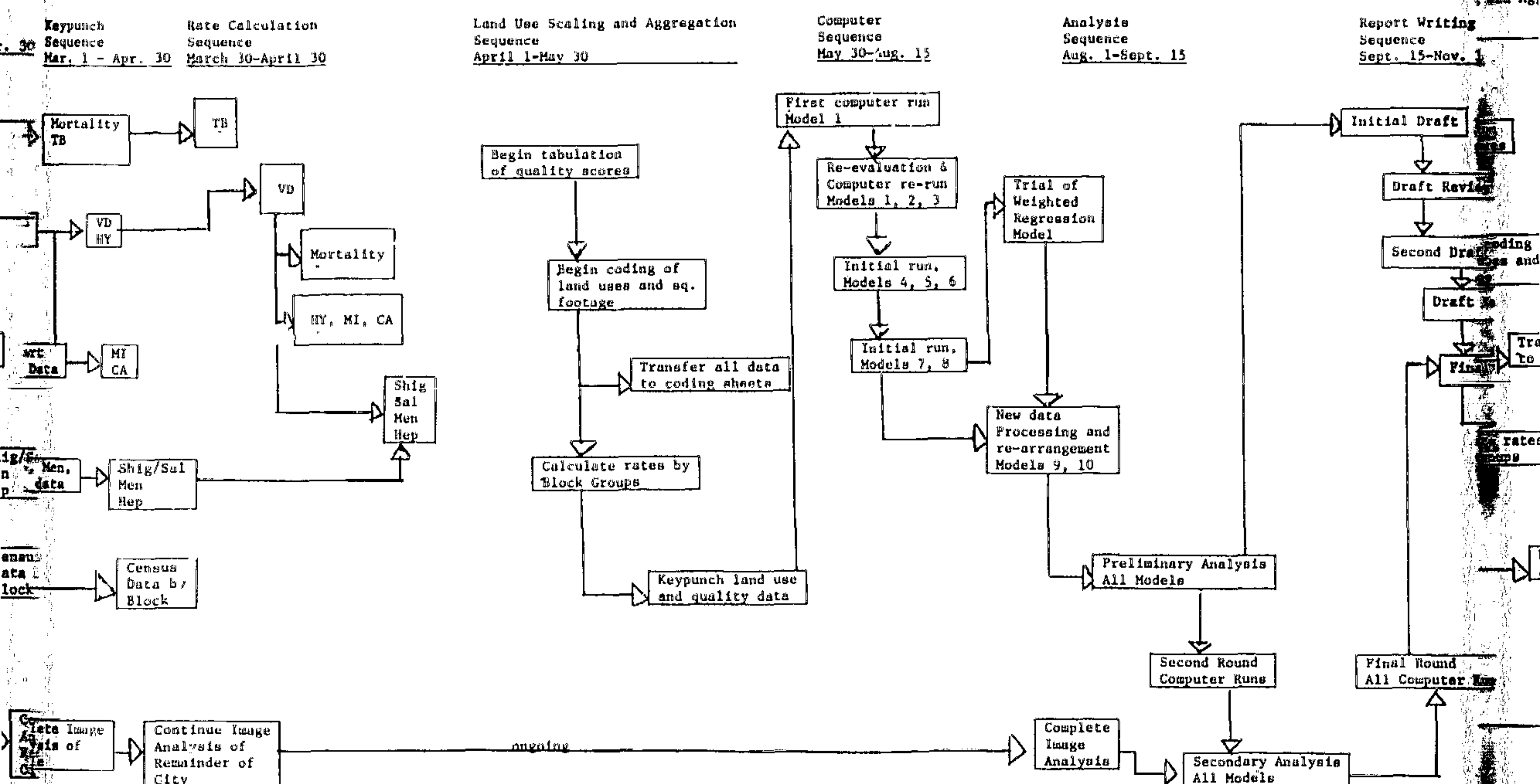
WORK PROGRAM: GALVESTON PROJECT



FOLDOUT FRAME

WORK PROGRAM: GALVESTON PROJECT

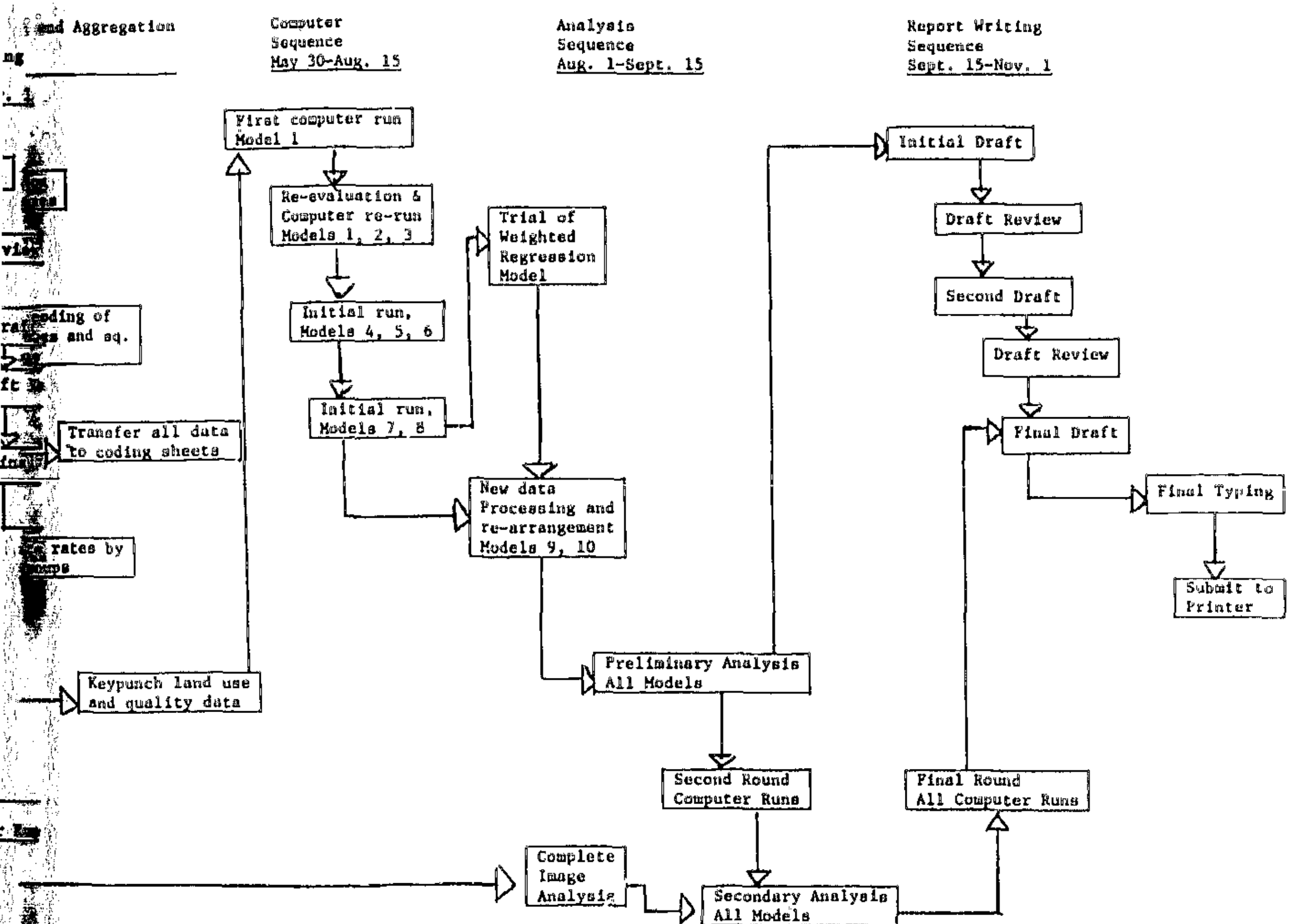
WORK PROGRAM: GALVESTON PROJECT



FOLDOUT FRAME

2

WORK PROGRAM: GALVESTON PROJECT



the planimeter, the grid, the dot pattern and the slide rule, and it had been determined that the grid method was as reliable as the planimeter and the dot pattern with very little range of error occurring between them.[1] For this reason, it was decided to use the combination of the grid and the slide rule conversion as the method of measurement.

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1. Rush, Marjorie and Vernon, Sally, Urban Environmental Health Applications of Remote Sensing, Contract NAS 9-12823, The University of Texas Health Science Center at Houston School of Public Health, December, 1973, (Unpublished).

SECTION IV

RESULTS AND SUMMARY

The results of the research undertaken in this project have demonstrated two main points:

1. That land use and residential quality indicators equal and sometimes surpass census indicators as predictors of morbidity and mortality levels.

2. That the association between land use, residential quality and negative health indices is a statistically significant one for most of the health indices selected.

What these two conclusions say in effect is that land use and residential quality act as surrogates for socio-economic status and cultural patterns. These spatially distributed characteristics can be measured and predicted through viewing the environment via remote sensing. Information regarding health levels of inhabitants of an environment can be inferred from that data interpreted from aerial photographs. This is demonstrated in the following sections.

TB, VD and the Environment

The two health indices which show the strongest association with the environment are tuberculoses and venereal disease. This confirms findings from other studies, inasmuch as these are "social" diseases which are often associated with certain socio-economic characteristics of the population.

The environmental characteristics associated with TB and VD are somewhat similar yet differ in detail. The particular land uses and quality

factors associated with each are listed below. The number next to each measure is the percentage of the variance in the regression equation which was accounted for by each measure. The higher the percentage of explained variance, the stronger the association. The direction of the association, i.e., positive or negative, is given in the sign column.

TB Model 4.4 SIGN	MEASURE	% VARIANCE	VD Model 8.4 SIGN	MEASURE	% VARIANCE
-	Paved Streets	57%	+	Litter	28%
-	Sq. Ft./Dwelling Unit	70%	+	Industry	48%
-	Vacant Land	73%	+	Multi-Family Res.	63%
-	Single Family Res.	75%	-	Curbs & Gutters	69%
-	Sidewalks	77%	-	House Size	71%
-	Litter	79%	+	Community Facilities	73%
-	General Condition	79%	-	Single Family Res.	73%
-	House Size	81%	+	Sidewalks	73%
-	Hi-Rise Apt.	82%	-	Paved Streets	73%
			+	Parking Lots	74%

The table indicates that in the case of VD, 74% of the variance was explained by the first ten variables or measures in the regression equation. In the case of TB this rose to 82%. These percentages are considered to be rather high, showing a very strong association between the environment and these two diseases.

These results become more interesting when viewed as a contrast between the census variables as the traditional predictors of health status, and the land use and environmental quality measures. The

comparison between the census as a predictor and land use/quality as a predictor for TB showed the census explaining 54% of the variation and land/use quality explaining 82% of the variation. For VD the differences were much smaller; 71% for the census and 74% for land use/quality. When the census and land use/quality measures were combined in one computer model the percentage of explanation rose only to 82%, which seems to indicate that census and land use/quality are measuring more or less the same thing. This would tend to substantiate the previous statements that land/use quality are simply surrogates for the characteristics of the population living in each of the ecological areas being analyzed. If this is the case, then the argument for use of remote sensing intercensally, or between census periods, can be given strong support.

The land use/quality measures were also better predictors than the census for mortality in the two age groups Under 18 and Between 18-61. The explained variations here are 20% for the census vs. 42% for land use/quality in the mortality age category Under 18. For deaths which could be called "premature" in the sense that they did not occur in the Over 62 age groups, the environment reflects conditions which may have lead to these earlier than normal deaths. What these conditions may be is a tangled web of socio-economic, cultural and environmental factors which this study does not go into.

Neighborhood profiles have been sketched for each of the dependent health variables. These profiles are based on the independent variables which showed the strongest association with each dependent health variable. The neighborhood profile for VD is included here as an example. The full report contains the complete set of neighborhood profiles.

Neighborhood Profile: Venereal Disease

A heavy mix of industrial and residential land uses with poor environmental maintenance appears to describe the neighborhood profile association with V.D. Industrial uses, multi-family and litter account for up to 70% of the variation in Models 8.2, 8.4 and 8.6.[1] When the census variable measuring black population enters the equation, these four independent variables account for 77% of the variation (see Model 8.1).

As is common in so many American cities, this type of neighborhood is to be found where public housing and older industrial establishments exist side by side. Since public housing is generally occupied by black families, this accounts for the association of percentage of blacks with multi-family units. (Simple correlation coefficient of .437, significant at .01 level.) In addition rooming houses converted from former single family dwellings often appear in these kinds of neighborhoods.

In this analysis, VD shows an overwhelming appearance, then, in the poorest neighborhoods of the city, populated predominantly by blacks. Since VD reporting suffers from an acknowledged bias in favor of the poor (upper and middle class whites suppress VD information) this neighborhood profile must be viewed with these facts in mind. While the disease data certainly acknowledges the overwhelming preponderance of cases appearing in this kind of neighborhood, it must be recognized that this does not preclude the existence of other types of neighborhoods where VD exists but is not a matter of public record.

1. See Appendix for detailed explanation of models.

Other Health Indices

The other health indices did not show quite so strong an association with land use and residential quality. However, five of the remaining eight show explained variation of over 40%; these are Mortality Under 18, Mortality between 18-61, hypertension, cardiac arrest/myocardial infarction (heart attack) and shigella/salmonella. The two variables which do not show highly significant levels of association with the environment are hepatitis and meningitis. Part of the reason for the poor showing of these latter two was that the number of cases occuring did not provide a full distribution over the city and therefore "gaps" in the data weakened the strength of the analysis.

The neighborhood profile for hepatitis is helpful in attempting to sketch the kinds of settings which are revealed by the computer model. While the levels of association are not as high as for the other dependent variables, significance levels were still acceptable. (See Appendix for full listing of levels of association.) It should be noted that the neighborhood profile is a composite of variables which presumably interact with each other. The reader will note in the neighborhood profile as given below, that the linkages between open vacant areas, litter, industrial uses and multi-family housing combine to reveal a kind of prototype setting in which hepatitis may be likely to occur.

The remainder of the regression model results can be noted in Appendix I, Models 1.1 through 10.6. These include each health index which was used in the study and the various computer models which were run to ascertain the level of association between different types of

independent variables: land use, residential quality and census. The health variables are numbered 1 through 10. The model numbers are decimals .1 through .6.

The model results basically show that health and poverty continue to be strongly inter-related, even into this decade with the extensive health intervention systems thus far developed. This is not an unusual finding but rather one which confirms previous research over many decades, linking poor housing and environmental conditions to poor health. However, these findings differ in that they were obtained through the use of remote sensing rather than through means of ground survey or census analysis.

These data also show that for some diseases, poverty is not the strongest predictor. For hypertension, and heart attacks, the land use and residential quality variables which show the strongest association were those characteristic of middle income neighborhoods. This does not mean that the poor do not also suffer from hypertension and heart attacks, but rather that the predominant ecological patterns of these diseases were quite different from the communicable diseases included in this study.

Neighborhood Profile: Hepatitis

When viewing the neighborhood profile for the distribution of hepatitis city-wide (Model 5.4), the regression model gives us a picture of a neighborhood of duplex type multi-family housing with developed open space, sidewalks, an absence of litter, wide streets and lot grontages and a lower ratio of dwelling units to total block group square footage, indicating lower external densities. These are predominantly residential areas

with little commercial or industrial usage. The predictive value of this model only reaches 28% at best, however, with significance levels between .005 and .01.

The profile changes decidedly when the mixed land use model (Model 5.6) is analyzed. Here we see neighborhoods which are of low quality with multi-family and industrial uses contiguous to each other, with small dwelling units, unpaved streets and a poorly maintained neighborhood appearance. Litter accounts for 20% of the variation in this model. The predictive value of the mixed land use model reaches to 80%, or about three times that of the model for the city as a whole.

The presence of litter in this mixed land use model repeats the outcome of the Houston study, which associated undeveloped land and streets with areas of refuse and trash. The additional connection to the neighborhood profile generated by the meningitis equation should be noted, in that the neighborhoods are not only of similar types, but the presence of litter as a result of alleyways, undeveloped areas and streets is striking in both models for both cities.

Since hepatitis is a disease which is often transmitted through infected shellfish, other food vehicles, and food handlers, the association between poor neighborhoods poorly maintained, is an indirect association between people with a greater likelihood of contracting hepatitis due to poor nutritional habits and higher succeptibility to disease in general rather than an association with land uses which harbor infected foods. It should also be pointed out that hepatitis is transmitted fecally as well as orally and therefore persons in poorly maintained physical environments would be at greater risk than those in well maintained neighborhoods.

Delineation of Poverty Neighborhoods

Poverty neighborhoods are revealed by the data in this report. Primarily mixed land uses of an older vintage (early 20th century industrial establishments, for instance, rather than newer post-war industrial parks), coupled with poor environmental maintenance are the most familiar characteristics. Lack of greenery and sidewalks, narrow streets, external and internal crowding yielding high densities both of buildings to total square footage and larger numbers of persons living in smaller dwelling units, are additional characteristics. There is almost a complete lack of natural or man-made amenity. Multi-family housing, rooming houses and single person households complete the picture.

The implications for health are obvious and well documented. Litter and poorly maintained streets, yards and alleyways are a breeding place for flies and insects which are disease carriers as well as a myriad of bacterial and viral hosts. People living in crowded conditions experience both psychological and physical stress, lowering body resistance to disease. Children who play in a poorly maintained environment are much more likely to contact and pass on disease to each other. The fecal and oral transmission of disease bacteria is facilitated in this kind of environment.

SUMMARY

Two points are reiterated. First, remote sensing is an excellent tool to use in recording an image of a city. With certain land use and quality variables selected for analysis, it can reveal an ecological map of the city much more quickly and thoroughly than ground survey techniques. Second, this ecological map can then be complimented and expanded by adding to it various social and health indicators which will give a more complete picture of the city suitable for further analysis. From the analysis stage the public and private sector may then move into the intervention stage for the purpose of altering the environment in such a way as to improve quality of life for urban residents.

The advantage of remote sensing over ground survey techniques is not only speed but continuity. The monitoring process can occur on an annual basis enabling decision-makers to keep up with change in the urban fabric and respond accordingly. Social and health indicators can also be gathered on a yearly basis, as indeed many are at the present time, and distributed spatially to complement the ecological map produced by remote sensing.

This study has been an attempt to operate in precisely this fashion, documenting the urban environment for an entire city in a rather short time period. In addition, the study has shown the viability of certain associations between the man-made environment and levels of health. More complete and thorough health data gathering procedures would make this kind of study even more fruitful, an area where improvement is needed.

In addition, the class fication system used in this study could be altered. It remains now for cities to adopt this methodology on a regular basis to speed up and refine data gathering processes presently employed.

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APPENDIX

Results of Computer Analysis

DEPENDENT VARIABLE 10; MENINGITIS

10.4 UNWEIGHTED REGRESSION
LAND USE/INDIVIDUAL QUALITY

SIGN	VARIABLE	R^2
-	SQ. FT./D.U.	.11
+	OPEN SPACE	.15
+	LITTER	.18
(±)	MULTI-FAMILY RES.	.20
+	CURBS & GUTTERS	.22
-	HOUSE SIZE	.30
+	HIGH RISE APT.	.32
-	PARKING LOTS	.34
(∓)	LOT FRONTAGE	.36
-	COMMERCIAL	.37

F. = 3.59
Sig. at. .001

10.5 QUALITY

SIGN	VARIABLE	R^2
+	STREET WIDTH	.09
-	DRIVEWAYS	.15
(∓)	LOT FRONTAGE	.189
+	PAVED STREET	.21
-	FOLIAGE	.22
(±)	CURBS & GUTTERS	.23
+	GENERAL CONDITION	.23

F. = 3.25
Sig. at. .005

10.6 SELECTED BLOCKS OF MIXED USES:
COMBINED LAND USE AND QUALITY

SIGN	VARIABLE	R^2
+	STREET WIDTH	.16
+	OPEN SPACE	.207
+	MULTI-FAMILY	.266
+	LITTER	.30
-	HOUSE SIZE	.319
+	CURBS & GUTTERS	.398
	STREET WIDTH REMOVED BY COMPUTER	
(±)	PAVED STREETS	.428
-	FOLIAGE	.44
(∓)	DRIVEWAYS	.46
-	VACANT	.496

F. = 3.56
Sig. at. 005

DEPENDENT VARIABLE 10; MENINGITIS

10.1 CENSUS AND LAND USE

SIGN	VARIABLE	R^2
−	AVG. VALUE-OWN. OCC. D.U.	.16
+	QUALITY INDEX	.21
+	>1.01 PERSONS PER ROOM	.24
(∓)	AVG. ROOMS/OWN. OCC.	.26
−	SQ. FT./D.U.	.277
(∓)	VACANT	.299
(±)	POPULATION/D. U.	.318
−	1 PERSON HOUSEHOLDS	.359
+	OPEN SPACE	.378
+	COMM. FACILITIES	.385

F. = 3.83
Sig. at. .005<>.001

10.2 LAND USE UNWEIGHTED

SIGN	VARIABLE	R^2
+	LITTER	.05
+	OPEN SPACE	.10
+	MULTI-FAMILY	.14
+	VACANT	.15
−	WATER	.158
+	QUALITY INDEX	.16
−	INDUSTRIAL	.17
+	HIGH RISE APTS.	.17
(∓)	PAVED AREAS	.17
−	COMMERCIAL	.175

F. = 2.79
Sig. at. .025<>.01

10.3 CENSUS ONLY

SIGN	VARIABLE	R^2
−	AVG. VAL.-OWN. OCC. D.U.	.16
+	% BLACK	.19
−	1 PERSON HOUSEHOLDS	.216
−	% UNDER 18	.23
+	>1.01 PERSONS PER ROOM	.246
−	POPULATION/D.U. RATIO	.27
−	TOTAL OWN. OCC./D.U	.28
+	TOTAL POPULATION	.29
+	AVG. ROOMS-OWN.OCC D.U.	.29
−	AVG. ROOMS-RENT. D.U.	.29

F. = 2.5
Sig. at. .025

NOTE: Where two signs are given, (the top sign is the simple correlation coefficient and the lower sign is the regression correlation coefficient). When only one sign is given both coefficients are in agreement.

DEPENDENT VARIABLE 9; SHIGELLA SALMONELLA

9.4 UNWEIGHTED REGRESSION
LAND USE/INDIVIDUAL QUALITY

SIGN	VARIABLE	R^2
+	OPEN SPACE	.22
+	MULTI-FAMILY RES.	.26
-	COMM. FACILITIES	.29
-	FOLIAGE	.33
(∓)	PAVED STREETS	.37
+	STREET WIDTH	.38
(∓)	HOUSE SIZE	.39
+	INDUSTRIAL	.40
-	PARKING LOTS	.41
+	CURBS & GUTTERS	.41
(∓)	SQ. FT./D.U.	.42

F. = 5.51
Sig. at. .001

9.5 QUALITY

SIGN	VARIABLE	R^2
-	FOLIAGE	.02
+	PAVED STREETS	.12
+	HOUSE SIZE	.16
+	LOT FRONTAGE	.17
-	SIDEWALKS	.18
+	CURBS & GUTTERS	.18
-	GENERAL CONDITION	.18
+	DRIVEWAY	.18
-	STREET WIDTH	.19

F. = 1.60
Sig. At. .25

9.6 SELECTED BLOCKS OF MIXED USES:
COMBINED LAND USE AND QUALITY

SIGN	VARIABLE	R^2
+	OPEN SPACE	.30
-	COMM. FACILITIES	.36
(±)	STREET WIDTH	.40
-	FOLIAGE	.425
+	CURBS & GUTTERS	.49
-	PARKING LOTS	.54
-	SINGLE FAMILY RES.	.579
(∓)	HOUSE SIZE	.59
(∓)	SIDEWALKS	.61
+	PAVED STREETS	.637

F. = 5.45
Sig. at. .001

DEPENDENT VARIABLE 9; SHIGELLA SALMONELLA

9.1 CENSUS AND LAND USE

SIGN	VARIABLE	R^2
+	OPEN SPACE	.22
-	AVG. VALUE-OWN. OCC. D.U.	.287
-	COMM. FACILITIES	.32
-	AVG. ROOMS-RENT. D.U.	.349
-	PAVED AREAS	.38
+	QUALITY INDEX	.40
+	MULTI-FAMILY RES.	.415
+	AVG. VALUE-RENT. D.U.	.427
-	COMMERCIAL	.437
+	% BLACK	.44

F. = 4.87
Sig. at. .001

9.2 LAND USE UNWEIGHTED

SIGN	VARIABLE	R^2
+	OPEN SPACE	.22
+	MULTI-FAMILY RES.	.26
-	COMM. FACILITIES	.298
$(\pm)$	INDUSTRIAL	.30
-	PAVED AREAS	.308
$(\mp)$	LITTER	.31
+	QUALITY INDEX	.31
-	COMMERCIAL	.31
-	SINGLE-FAMILY RES.	.31
$(\pm)$	VACANT	.31

F. = 2.79
Sig. at. .005

9.3 CENSUS ONLY

SIGN	VARIABLE	R^2
-	AVG. VALUE-OWN. OCC. DU	.10
-	AVG. ROOMS-RENT. D.U.	.13
-	1 PERSON HOUSEHOLDS	.20
+	AVG. VALUE-RENT. D.U.	.23
-	TOTAL POPULATION	.24
+	% BLACK	.248
+	% OVER 62	.25
+	% UNDER 18	.25
-	>1.01 PERSONS PER ROOM	.25
-	TOTAL OWN. OCC. D.U.	.25

F. = 2.08
Sig. at. .05<>.025

NOTE: Where two signs are given, (the top sign is the simple correlation coefficient and the lower sign is the regression correlation coefficient).

DEPENDENT VARIABLE 8; VD

8.4 UNWEIGHTED REGRESSION LAND USE/INDIVIDUAL QUALITY

SIGN	VARIABLE	R^2
+	LITTER	.28
+	INDUSTRY	.48
+	MULTI-FAMILY RES.	.63
(∓)	CURBS & GUTTERS	.69
-	HOUSE SIZE	.71
+	COMM. FACILITIES	.73
-	SINGLE-FAMILY RES.	.73
(±)	SIDEWALKS	.73
(∓)	PAVED STREETS	.73
+	PARKING LOTS	.74

F. = 17.58
Sig. at. .001

8.5 QUALITY

SIGN	VARIABLE	R^2
-	DRIVEWAYS	.22
+	SIDEWALKS	.26
-	FOLIAGE	.29
(∓)	GENERAL CONDITION	.33
(∓)	PAVED STREETS	.35
-	HOUSE SIZE	.35
-	LOT FRONTAGE	.36
+	STREET WIDTH	.36

F. = 4.02
Sig. at. .001

8.6 SELECTED BLOCKS OF MIXED USES: COMBINED LAND USE AND QUALITY

SIGN	VARIABLE	R^2
+	INDUSTRIAL	.298
+	LITTER	.57
+	MULTI-FAMILY	.72
(∓)	CURBS & GUTTERS	.75
-	HIGH RISE APT.	.77
-	SINGLE-FAMILY RES.	.78
-	HOUSE SIZE	.787
(∓)	COMM. FACILITIES	.79
(∓)	SQ. FT./D.U.	.80
(∓)	PARKING LOTS	.808

F. = 13.12
Sig. at. .001

DEPENDENT VARIABLE 8; VD

8.1 CENSUS AND LAND USE

SIGN	VARIABLE	R^2
+	% BLACK	.62
+	INDUSTRIAL	.707
+	MULTI-FAMILY RES.	.748
+	LITTER	.769
+	PAVED AREAS	.778
(∓)	QUALITY INDEX	.79
+	COMM. FACILITIES	.79
-	HIGH RISE APTS.	.795
(∓)	AVG. VALUE-RENT. D.U.	.797
(∓)	% OVER 62	.80

F. = 24.62
Sig. at. .001

8.2 LAND USE UNWEIGHTED

SIGN	VARIABLE	R^2
+	LITTER	.28
+	INDUSTRIAL	.46
+	MULTI-FAMILY RES.	.61
(±)	COMM. FACILITIES	.63
(∓)	QUALITY INDEX	.64
-	HIGH RISE APT.	.65
+	PARKING LOTS	.66
-	OPEN SPACE	.67
-	VACANT	.67
-	SINGLE-FAMILY RES.	.67

F. = 12.71
Sig. at. .001

8.3 CENSUS ONLY

SIGN	VARIABLE	R^2
+	% BLACK	.62
-	TOTAL OWN. OCC. D.U.	.66
+	<1.01 PERSONS PER ROOM	.67
+	AVG. VAL.-OWN. OCC. D.U.	.69
+	TOTAL D.U.	.70
(±)	TOTAL RENT./D.U.	.71
-	TOTAL POPULATION	.71
-	% UNDER 18	.71
-	1 PERSON HOUSEHOLDS	.71
-	POPULATION/D.U. RATIO	.68
-	%OVER 62	.71

F. = 15.20
Sig. at. .001

NOTE: Where two signs are given, (the top sign is the simple correlation coefficient and the lower sign is the regression correlation coefficient). When only one sign is given both coefficients are in agreement.

DEPENDENT VARIABLE 7;

CARDIAC ARREST/MYOCARDIAL INFARCTION

7.4 UNWEIGHTED REGRESSION LAND USE/INDIVIDUAL QUALITY

SIGN	VARIABLE	R^2
+	HOUSE SIZE	.09
+	COMMERCIAL	.17
-	PARKING LOTS	.24
(±)	LOT FRONTAGE	.28
+	OPEN SPACE	.30
+	SIDEWALKS	.33
(±)	CURBS & GUTTERS	.38
+	STREET WIDTH	.42
+	FOLIAGE	.44
+	SQ. FT./D.U.	.45

F. = 4.97
Sig. at. .001

7.5 QUALITY

SIGN	VARIABLE	R^2
+	HOUSE SIZE	.09
-	DRIVEWAYS	.15
-	CURBS & GUTTERS	.19
+	STREET WIDTH	.25
+	PAVED STREETS	.27
+	FOLIAGE	.27
-	GENERAL CONDITION	.28

F. = 2.74
Sig. at. .01

7.6 SELECTED BLOCKS OF MIXED USES: COMBINED LAND USE AND QUALITY

SIGN	VARIABLE	R^2
+	COMMERCIAL	.15
-	PARKING LOTS	.258
+	STREET WIDTH	.46
+	HOUSE SIZE	.55
-	LITTER	.597
-	INDUSTRIAL	.637
(∓)	SQ. FT./D.U.	.649
-	MULTI-FAMILY RES.	.65
+	PAVED STREETS	.659

F. = 7.79
Sig. at. .001

DEPENDENT VARIABLE 6; HYPERTENSION

6.4 UNWEIGHTED REGRESSION LAND USE/INDIVIDUAL QUALITY

SIGN	VARIABLE	R^2
+	DRIVEWAYS	.12
-	VACANT	.22
-	CURBS & GUTTERS	.31
-	WATER	.37
+	GENERAL CONDITION	.39
(∓)	PARKING LOTS	.41
-	COMM. FACILITIES	.42
+	LOT FRONTAGE	.43
(∓)	LITTER	.44
-	SIDEWALKS	.45

F. = 5.06
Sig. at. .001

6.5 QUALITY

SIGN	VARIABLE	R^2
+	DRIVEWAYS	.12
-	PAVED STREETS	.157
+	GENERAL CONDITION	.187
(∓)	STREET WIDTH	.209
+	FOLIAGE	.22
(±)	FRONTAGE	.23
-	SIDEWALKS	.24

F. = 2.77
Sig. at. .01

6.6 SELECTED BLOCKS OF MIXED USES: COMBINED LAND USE AND QUALITY

SIGN	VARIABLE	R^2
-	VACANT	.06
+	OPEN SPACE	.139
+	MULTI-FAMILY RES.	.19
(±)	STREET WIDTH	.245
(∓)	LITTER	.267
+	CURBS & GUTTERS	.29
-	WATER	.30
+	DRIVEWAYS	.31
(±)	HOUSE SIZE	.347
-	SINGLE FAMILY RES.	.357

F. = 1.72
Sig. at. .10

DEPENDENT VARIABLE 7;

CARDIAC ARREST/MYOCARDIAL INFARCTION

7.1 CENSUS AND LAND USE

SIGN	VARIABLE	R^2
+	% OVER 62	.26
+	SQ. FT./D.U.	.34
+	AVG. ROOMS-RENT. D.U.	.40
+	COMMERCIAL	.42
-	1 PERSON HOUSEHOLDS	.45
-	AVG. VALUE-OWN. OCC. D.U.	.466
-	>1.01 PERSON HOUSEHOLDS	.50
-	TOTAL OWN. OCC. D.U.	.52
(±)	AVG. VALUE-RENT. D.U.	.537
-	% BLACK	.55

F. = 7.50
Sig. at. .001

7.2 LAND USE UNWEIGHTED

SIGN	VARIABLE	R^2
+	OPEN SPACE	.04
-	VACANT	.09
+	COMMERCIAL	.12
-	PAVED AREAS	.17
+	QUALITY INDEX	.21
-	INDUSTRIAL	.23
-	MULTI-FAMILY RES.	.25
+	HIGH RISE APT.	.26

F. = 2.33
Sig. at. .025

7.3 CENSUS ONLY

SIGN	VARIABLE	R^2
+	% OVER 62	.26
-	1 PERSON HOUSEHOLDS	.34
-	% BLACK	.37
-	AVG. VALUE-OWN. OCC. D.U.	.40
-	>1.01 PERSON PER ROOM	.43
-	TOTAL OWN. OCC. D.U.	.45
+	AVG. ROOMS-RENT. D.U.	.47
+	% UNDER 18	.49
+	POPULATION/D. U. RATIO	.498
-	AVG. ROOMS-OWN. OCC. D.U.	.50

F. = 6.14
Sig. at. .001

NOTE: Where two signs are given, (the top sign is the simple correlation coefficient and the lower sign is the regression correlation coefficient). When only one sign is given both coefficients are in agreement.

DEPENDENT VARIABLE 6; HYPERTENSION

6.1 CENSUS AND LAND USE

SIGN	VARIABLE	R^2
+	AVG. VALUE-OWN. OCC. D.U.	.19
+	% OVER 62	.35
-	VACANT	.39
-	TOTAL D.U.	.426
-	COMM. FACILITIES	.47
$(\mp)$	% BLACK	.50
$(\pm)$	QUALITY INDEX	.518
-	COMMERCIAL	.54
+	AVG. VALUE-RENT D.U.	.55
$(\mp)$	LITTER	.56

F. = 7.97
Sig. at..001

6.2 LAND USE UNWEIGHTED

SIGN	VARIABLE	R^2
+	SINGLE FAMILY RES.	.07
-	INDUSTRIAL	.09
-	VACANT	.10
+	QUALITY INDEX	.11
-	MULTI-FAMILY RES.	.11
+	HIGH RISE APT.	.12
-	WATER	.12
-	COMM. FACILITIES	.12

F. = 1.19
Not Significant

6.3 CENSUS ONLY

SIGN	VARIABLE	R^2
+	AVG. VALUE-OWN.OCC. D.U.	.19
+	% OVER 62	.35
+	AVG. ROOMS-OWN.OCC. D.U.	.37
-	TOTAL D.U.	.40
+	% BLACK	.416
-	POPULATION/D. U. RATIO	.42
+	TOTAL POPULATION	.47
-	>1.01 PERSONS PER ROOM	.48
-	TOTAL RENTAL UNITS	.48
-	TOTAL OWN. OCC. D.U.	.49

F. = 5.98
Sig. at. .001

NOTE: Where two signs are given, (the top sign is the simple correlation coefficient and the lower sign is the regression correlation coefficient). When only one sign is given both coefficients are in agreement.

DEPENDENT VARIABLE 5; HEPATITIS

5.4 UNWEIGHTED REGRESSION
LAND USE/INDIVIDUAL QUALITY

SIGN	VARIABLE	R^2
+	MULTI-FAMILY	.05
+	OPEN SPACE	.13
+	SIDEWALKS	.16
-	LITTER	.19
-	HOUSE SIZE	.21
-	PARKING LOTS	.23
+	STREET WIDTH	.25
+	LOT FRONTAGE	.26
-	COMM. FACILITIES	.27
-	DWELL. UNIT/SQ. FT.	.28

F. = 2.39
Sig. at. .025<>.01

5.5 QUALITY

SIGN	VARIABLE	R^2
+	SIDEWALKS	.05
+	HOUSE SIZE	.07
+	CURBS & GUTTERS	.09
+	STREET WIDTH	.10
-	FOLIAGE	.11
+	LOT FRONTAGE	.14
+	GENERAL CONDITION	.14
-	DRIVEWAY	.15

F. = 1.00
NOT SIGNIFICANT

5.6 SELECTED BLOCKS OF MIXED USES:
COMBINED LAND USE AND QUALITY

SIGN	VARIABLE	R^2
+	INDUSTRIAL	.29
+	LITTER	.54
+	MULTI-FAMILY RES.	.71
(∓)	CURBS & GUTTERS	.74
-	HOUSE SIZE	.76
-	APTS.-HIGH RISE	.77
(∓)	COMM. FACILITIES	.78
(∓)	DWELL UNIT/SQ. FT.	.78
(∓)	PARKING LOTS	.79
(∓)	OPEN SPACE	.80

F. = 12.54
Sig. at. .001

DEPENDENT VARIABLE 5; HEPATITIS

5.1 CENSUS AND LAND USE

SIGN	VARIABLE	R^2
+	MULTI-FAMILY	.05
+	OPEN SPACE	.13
+	% OVER 62	.16
+	AVG. ROOMS-RENT. D. U.	.187
-	COMM. FACILITIES	.208
(∓)	VACANT	.22
-	AVG. VALUE-RENT. D.U.	.24
(±)	SQ. FT./D.U.	.25
+	QUALITY INDEX	.26
(±)	% BLACK	.278

F. = 2.35
Sig. at. .025

5.2 LAND USE UNWEIGHTED

SIGN	VARIABLE	R^2
+	MULTI-FAMILY RES.	.05
+	OPEN SPACE	.13
+	QUALITY INDEX	.15
-	COMM. FACILITIES	.16
-	WATER	.17
(±)	INDUSTRIAL	.17
+	HIGH RISE APT.	.18
	COMMERCIAL	.18
	SINGLE FAMILY RES.	.18
	VACANT	.19

F. = 1.47
Sig. at. .25

5.3 CENSUS ONLY

SIGN	VARIABLE	R^2
-	AVG. VALUE-OWN.OCC. D.U.	.04
+	AVG. ROOMS-RENT D.U.	.06
+	% OVER 62	.09
+	% UNDER 18	.11
-	% BLACK	.12
+	>1.01 PERSONS PER ROOM	.13
-	POPULATION/D. U.	.14
-	TOTAL OWN. OCC. D.U.	.149
-	1 PERSON HOUSEHOLDS	.15
+	TOTAL RENTAL D. U.	.16

F. = 1.17
Sig. at. .25

NOTE: Where two signs are given, (the top sign is the simple correlation coefficient and the lower sign is the regression correlation coefficient). When only one sign is given both coefficients are in agreement.

DEPENDENT VARIABLE 4; TB

4.4 UNWEIGHTED REGRESSION LAND USE/INDIVIDUAL QUALITY

SIGN	VARIABLE	R^2
-	PAVED STREETS	.57
-	SQ. FT./DWELL. UNIT	.70
-	VACANT	.73
-	SINGLE-FAMILY RES.	.75
-	STREET WIDTH	.77
(∓)	SIDEWALKS	.77
-	LITTER	.79
-	GENERAL CONDITION	.79
(∓)	HOUSE SIZE	.81
-	HIGH RISE APT.	.82

F. = 28.42
Sig. at. .001

4.5 QUALITY

SIGN	VARIABLE	R^2
-	PAVED STREETS	.57
-	DRIVEWAY	.65
(∓)	SIDEWALKS	.66
-	GENERAL CONDITION	.66
-	STREET WIDTH	.67
-	FOLIAGE	.67

F. = 17.94
Sig. at. .001

4.6 SELECTED BLOCKS OF MIXED USES: COMBINED LAND USE AND QUALITY

SIGN	VARIABLE	R^2
+	COMMERCIAL	.209
-	VACANT	.34
-	PAVED STREETS	.51
-	LITTER	.59
-	SQ. FT./D.U.	.61
(±)	PARKING LOTS	.64
+	SIDEWALKS	.65
-	MULTI-FAMILY RES.	.668
-	SINGLE FAMILY RES.	.678
-	DRIVEWAYS	.689

F. = 6.87
Sig. at. .001

DEPENDENT VARIABLE 4; TB

4.1 CENSUS AND LAND USE

SIGN	VARIABLE	R^2
+	INDUSTRIAL	.368
+	1 PERSON HOUSEHOLDS	.639
-	QUALITY INDEX	.579
-	VACANT	.606
-	LITTER	.627
+	>1.01 PERSONS PER ROOM	.55
+	AVG. VALUE-OWN. OCC. D.U.	.657
-	TOTAL POPULATION	.667
-	% OVER 62	.67
-	POPULATION/D.U. RATIO	.678

F. = 12.85
Sig. at..001

4.2 LAND USE UNWEIGHTED

SIGN	VARIABLE	R^2
+	INDUSTRIAL	.43
+	COMMERCIAL	.52
-	VACANT	.58
-	QUALITY INDEX	.63
-	LITTER	.65
(∓)	PAVED AREAS	.65
+	COMM. FACILITIES	.66
(∓)	MULTI-FAMILY	.66
-	SINGLE FAMILY	.67
-	WATER	.67

F. = 12.93
Sig. at. .001

4.3 CENSUS ONLY

SIGN	VARIABLE	R^2
+	1 PERSON HOUSEHOLDS	.31
+	% UNDER 18	.38
+	TOTAL POPULATION	.45
+	>1.01 PERSONS PER ROOM	.47
-	% BLACK	.49
-	POPULATION/D.U. RATIO	.509
+	AVG. RMS./OWN. OCC. D.U.	.52
-	TOTAL D.U.	.53
-	% OVER 62	.54
+	AVG. RMS./RENT. D.U.	.54

F. = 7.22
Sig. at. .001

NOTE: Where two signs are given, (the top sign is the simple correlation coefficient and the lower sign is the regression correlation coefficient). When only one sign is given both coefficients are in agreement.

AGE ADJUSTED 1971-72 MORTALITY

DEPENDENT VARIABLE 3; MORTALITY OVER AGE 62

3.4 COMBINED LAND USE & QUALITY FOR TOTAL CITY

SIGN	VARIABLE	R^2
+	SQ. FT./D.U.	.07
+	COMM. FACILITIES	.158
-	OPEN SPACE	.176
+	COMMERCIAL	.189
+	FOLIAGE	.197
+	INDUSTRIAL	.22
(∓)	MULTI-FAMILY RES.	.24
-	WATER	.25
+	PAVED STREETS	.25
-	CURBS & GUTTERS	.26

F. = 2.35
Sig. at. .02<>.05

3.5 QUALITY

SIGN	VARIABLE	R^2
+	SIDEWALKS	.03
-	STREET WIDTH	.05
-	HOUSE SIZE	.06
(±)	DRIVEWAY	.08
-	CURBS & GUTTERS	.09
-	GENERAL CONDITION	.10
+	PAVED STREETS	.10

F. = 1.34
Sig. at. .25

3.6 SELECTED BLOCKS OF MIXED USES: COMBINED LAND USE AND QUALITY

SIGN	VARIABLE	R^2
+	FOLIAGE	.17
+	COMM. FACILITIES	.248
+	PAVED STREETS	.285
-	OPEN SPACE	.324
-	CURBS & GUTTERS	.360
+	INDUSTRIAL	.409
+	COMMERCIAL	.459
+	HOUSE SIZE	.49
-	WATER	.51
-	HIGH RISE APT.	.518

F. = 3.39
Sig. at. .005

AGE ADJUSTED 1971-72 MORTALITY

DEPENDENT VARIABLE 3; MORTALITY OVER AGE 62

3.1 CENSUS AND LAND USE COMBINED

SIGN	VARIABLE	R^2
+	QUALITY INDEX	.16
+	COMM. FACILITIES	.21
+	SQ. FT./D.U.	.24
+	COMMERCIAL	.27
-	WATER	.29
+	MULTI-FAMILY	.30
(∓)	INDUSTRIAL	.307
(∓)	1 PERSON HOUSEHOLDS	.31
+	TOTAL/RENT. D.U.	.32

F. = 2.35
Sig. at.025

3.2 LAND USE

SIGN	VARIABLE	R^2
+	QUALITY INDEX	.16
+	COMM.FACILITIES	.21
+	D.U. PER BLOCK GROUP	.24
+	COMMERCIAL	.27
-	WATER	.29
+	MULTI-FAMILY	.30
(∓)	INDUSTRIAL	.307

F. = 2.76
Sig. at. .01

3.3 CENSUS

SIGN	VARIABLE	R^2
+	AVG. VALUE-OWN.OCC D.U.	.03
(±)	AVG. ROOMS-OWN.OCC. D.U.	.04
(±)	1 PERSON HOUSEHOLD	.048
(±)	>1.01 PERSON PER ROOM	.05
-	TOTAL OWN. OCC. D.U.	.07
+	TOTAL RENTAL D.U.	.08
-	AVG. RENT	.09
+	AVG. ROOMS-RENT. D.U.	.10
-	% BLACK	.11
-	POPULATION/D.U.	.12

F. = .80
Not Significant

NOTE: Where two signs are given, (the top sign is the simple correlation coefficient and the lower sign is the regression correlation coefficient). When only one sign is given both coefficients are in agreement.

AGE ADJUSTED 1971-72 MORTALITY

DEPENDENT VARIABLE 2; MORTALITY AGES 18-61

2.4 COMBINED LAND USE & QUALITY FOR TOTAL CITY

SIGN	VARIABLE	R^2
-	HOUSE SIZE	.22
+	INDUSTRIAL	.277
+	WATER	.319
-	VACANT	.35
+	OPEN SPACE	.40
(∓)	LOT FRONTAGE	.44
-	CURBS & GUTTERS	.458
(∓)	LITTER	.47
-	HIGH RISE APT.	.48
(∓)	SIDEWALKS	.49

F. = 5.90
Sig. at. .001

2.5 QUALITY

SIGN	VARIABLE	R^2
-	FOLIAGE	.19
-	PAVED STREETS	.23
-	DRIVEWAY	.25
-	CURBS & GUTTERS	.25
(∓)	FRONTAGE	.27
-	GENERAL CONDITION	.28
-	STREET WID.	.29
-	HOUSE SIZE	.30

F. = 3.57
Sig. at..005

2.6 SELECTED BLOCKS OF MIXED USES: COMBINED LAND USE AND QUALITY

SIGN	VARIABLE	R^2
-	VACANT	.089
-	HOUSE SIZE	.189
+	LOT FRONTAGE	.289
+	OPEN SPACE	.34
+	WATER	.397
+	INDUSTRIAL	.41
+	DRIVEWAYS	.428
-	HIGH RISE APTS.	.44
+	SIDEWALKS	.456
-	FOLIAGE	.46

F. = 2.68
Sig. at. .01

AGE ADJUSTED 1971-72 MORTALITY

DEPENDENT VARIABLE 2; MORTALITY AGES 18-61

2.1 CENSUS AND LAND USE COMBINED

SIGN	VARIABLE	R^2
+	% BLACK	.20
+	WATER	.25
+	1 PERSON HOUSEHOLDS	.29
+	>1.01 PERSONS PER ROOM	.31
-	AVG. VALUE-RENT. D.U.	.34
(∓)	SQ. FT./D.U.	.36
-	VACANT	.37
+	INDUSTRIAL	.39
(±)	% UNDER 18	.40
+	TOTAL D. U.	.41

F. = 4.95
Sig. at. .001

2.2 LAND USE

SIGN	VARIABLE	R^2
+	MULTI-FAMILY	.09
+	INDUSTRIAL	.15
+	WATER	.20
+	LITTER	.25
-	VACANT	.28
-	HIGH RISE APT.	.31
+	COMM. FACILITIES	.31
+	SQ. FT./D.U.	.32

F. = 2.97
Sig. at. .001

2.3 CENSUS

SIGN	VARIABLE	R^2
+	1 PERSON HOUSEHOLD	.12
-	AVG. RENT	.20
-	TOTAL D. U.	.23
+	>1.01 PERSONS PER ROOM	.27
(±)	POPULATION/D.U.	.31
-	% OVER 62	.33
-	AVG. VALUE OWN. OCC. D.U.	.338
+	TOTAL POPULATION	.34
-	TOTAL RENTAL D.U.	.346
-	TOTAL OWN. OCC. D.U.	.35

F. = 3.27
Sig. at. .001

NOTE: Where two signs are given, (the top si is the simple correlation coefficient and the lower sign is the regression correlation coefficient). When only one sign is given both coefficients are in agreement.

AGE ADJUSTED 1971-72 MORTALITY

DEPENDENT VARIABLE 1; MORTALITY UNDER 18

1.4 COMBINED LAND USE & QUALITY FOR TOTAL CITY

SIGN	VARIABLE	R^2
+	INDUSTRIAL	.159
+	PAVED STREET	.337
-	LOT FRONTAGE	.357
+	CURBS & GUTTERS	.37
(∓)	SQ. FT./D.U.	.38
-	GENERAL CONDITION	.39
+	HOUSE SIZE	.397
+	MULTI-FAMILY RES.	.407
-	HIGH RISE APT.	.41
(∓)	VACANT	.42

F. = 4.45
Sig. at. .001

1.5 QUALITY

SIGN	VARIABLE	R^2
+	STREET WIDTH	.03
-	GENERAL CONDITION	.079
+	CURBS & GUTTERS	.08
-	FOLIAGE	.09
(∓)	HOUSE SIZE	.10
-	LOT FRONTAGE	.105
(∓)	STREET WIDTH	.107
-	SIDEWALKS	.107

F. = .95
Not Significant

1.6 SELECTED BLOCKS OF MIXED USES: COMBINED LAND USE AND QUALITY

SIGN	VARIABLE	R^2
+	INDUSTRIAL	.31
+	PAVED STREETS	.437
+	MULTI-FAMILY	.448
+	VACANT	.46
+	COMM. FACILITIES	.479
+	SQ. FT./D.U.	.488
+	STREET WIDTH	.527
+	PARKING LOTS	.54
-	HIGH RISE APT.	.55
+	CURBS & GUTTERS	.55

F. = 3.89
Sig. at. .005

AGE ADJUSTED 1971-72 MORTALITY

DEPENDENT VARIABLE 1; MORTALITY UNDER 18

1.1 UNDER 18 MORTALITY CENSUS AND LAND USE COMBINED

SIGN	VARIABLE	R^2
+	INDUSTRIAL	.20
+	% BLACK	.25
+	LITTER	.27
(∓)	1 PERSON HOUSEHOLDS	.29
-	COMMERCIAL	.31
-	AVG. # ROOMS, RENT. D.U.	.31
+	AVG. # ROOMS, OWN. OCC. D.U.	.35
+	TOTAL # RENT. D.U.	.36
+	MULTI-FAMILY	.39
+	TOTAL POPULATION	.41

F. = 3.74
Sig. at. .001

1.2 UNDER 18 MORTALITY AND LAND USE.

SIGN	VARIABLE	R^2
+	INDUSTRY	.20
+	MULTI-FAMILY	.24
-	VACANT	.25
-	QUALITY INDEX	.26
-	HIGH RISE APT.	.27
+	PARKING LOTS	.27
-	COMMERCIAL	.28

F. = 2.44
Sig. at. .025

1.3 UNDER 18 MORTALITY CENSUS

SIGN	VARIABLE	R^2
+	% BLACK	.12
-	AVG. ROOMS, RENT. D.U.	.16
+	% UNDER 18	.165
(±)	>1.01 PERSONS PER ROOM	.169
-	AVG. VALUE OWN.OCC. D.U.	.17
+	AVG. ROOMS OWN.OCC. D.U.	.18
+	1 PERSON HOUSEHOLDS	.19
(±)	TOTAL POPULATION	.198
+	AVG. RENT	.20
+	POPULATION/D. U.	.207

F. = 1.60
Sig. at. .25

NOTE: Where two signs are given, (the top sign is the simple correlation coefficient and the lower sign is the regression correlation coefficient). When only one sign is given both coefficients are in agreement.